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THE MADONNA LILY

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HISTORY

The Madonna lily is one of the oldest lilies in cultivation. It has been well recognized and its praises have been sung since the beginning of modern history. Since early in the Christian era it has figured in the annals of the church, and until 40 or 50 years ago it was the characteristic Easter flower, accepted and utilized as an emblem of purity. On account of its associations it is variously referred to as the Annunciation lily, St. Joseph's lily, Lent lily, Madonna lily, etc. The Swedish botanist Linnæus called it *Lilium candidum*, recognizing in the specific name its purity of color. It is native mainly of south-central Europe, whence it has traveled with man through all temperate climates.

Having been in cultivation so long the characteristics of the Madonna lily are well known, and there is a greater store of information about it in literature possibly than about any other lily, but since facts must be passed on from one to another and it is necessary for each generation to learn anew it is desirable to bring together here some of these data, as well as some not before printed, that it may be available to the prospective producer of bulbs in this country.

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In spite of the length of time the species has been known and the wealth of information about it, it is found that failure rather than success rules in attempts to propagate it, though the species is one of the easiest to handle of the entire genus Lilium. As in very many other cases relating to bulbous stocks, the data available refer to garden and greenhouse use. There has been very little discussion of the preparation and perfection of stocks for these purposes. In other words, the available information is useful to the grower of the plants rather than the producer of the bulbs.

VARIETIES

At one time a number of more or less well marked varieties of *Lilium candidum* were offered for sale, but so far as our present purposes are concerned they need not be considered in detail. Attention need be given here to one only, the robust, healthy, thick and leathery petaled variety which is about the only one seen to-day.

It is well to know, however, that there is a thin narrow-petaled weaker variety which should be avoided. Besides this, there is a double variety, and doubling may occur occasionally in the good commercial form. This feature is interesting but scarcely worth growing for decorative purposes. There is also a form with yellowish margins on the leaves, some with red, purplish, or black stems and some with even the blossoms streaked on the ribs with a blush of purple. None of these are attractive enough, strong enough, or appealing enough to persist and come into favor like the thick wide-petaled common commercial variety.

SOURCES OF PLANTING STOCKS

Material for propagation is to be had to-day mainly from imported stocks, for although the Madonna lily is commonly grown commercial quantities of bulbs are not yet available. The importations come chiefly from the north of France, which is the principal source of supply for the world as well as the source of the best stocks that are commercially grown at present.

Aside from this imported material there is a limited quantity of stock in this country. Some of this is excellent, especially when it has been left undisturbed for years. Old clumps commonly contain many small bulbs and a few large ones, from which commercial stocks can be worked up rather rapidly.

PROPAGATION

To be widely and extensively used a lily plant must be capable of being rapidly multiplied. Few lilies excel the Madonna in this respect, for it may be increased satisfactorily by several distinct methods.

PROPAGATION BY BULBS

The Madonna lily increases naturally by a division of its bulbs, and always associated with this natural division of the old bulb is another propagation from the old loosened and injured outer scales which break off in handling. These scales give rise natu-

rally to bulblets, which "grow up" in two or three years. Division of bulbs is the method of reproduction which has been generally employed in this country by growers who have not been sufficiently venturesome to try other methods. It is very efficient, at best only moderately rapid, but not quick enough for the commercial grower.

PROPAGATION BY SCALES

Propagation by scales (Pl. I, fig. 1) is very much to be preferred to all other methods, as it is very rapid and certain if properly applied. Only the older, outer, thick, heavy scales are employed. The younger, tender, smaller ones in the inside of the bulb should not be removed, because in the first place they have not substance enough to propagate well, and in the second place they are needed to protect the growing point (center) of the old bulb. The bulbs are reduced in size to about 14 centimeters (5.51 inches) in circumference by the removal of scales. These scaled bulbs are then entirely satisfactory for planting again and will grow to maximum size in two years. Some of the bulbs so treated, in addition to breaking up into two or three by division, will sometimes form bulblets on the old scale bases and on the plate of the mother bulb.

As soon as convenient after the scales are broken off from the bulbs, and always within a few days, they should be planted. The writer's favorite method is to open up a bed in Dutch fashion. The soil is removed from a 3-foot bed to a depth of about 2 inches. The scales are then distributed in rows 6 inches apart and about 1 inch apart in the row. When the bed is planted the scales are covered with the soil removed in opening the next bed to the same depth.

It should be emphasized that the planting of scales should be shallow. Under any condition 2 inches is deep enough, and 1½ inches if on a heavy loam.

The time at which the scales should be planted is very important. The operation should be early. One should not hesitate to dig the plants when in full blossom. Indeed, this is the best time to do the propagating, because then the long warm season is ahead to give a long incubation period for the development of the bulblets to a size which will enable them to throw up green leaves in the fall before it gets too cold. At least one should not wait long after the flowers have faded but should get the bulbs up and the scales planted as soon as possible.

The danger in the late planting of the scales lies in the fact that the season for the proper development of the bulblets is shortened. This is especially true in the Pacific Northwest, where the seasons are short, and if the planting there is delayed for six weeks the cold wet weather comes on and the scales, instead of producing bulblets, start to rot at the base and along their edges to such an extent as often to be almost, if not quite, a complete failure.

One should not make the mistake of attempting to keep the scales wet enough for ordinary plant growth. If planted in the open ground they should be quite dry for a month or six weeks at least. On Puget Sound the soil in the field is usually in suitable condition for this propagation in July and August. In the eastern United States and other regions where the summers are likely to be wet it is usually

better to propagate in frames or in a shed where the moisture conditions can be controlled. On the Pacific coast, however, the soil is dry enough and on the California coast often a little too dry, so that it may be advantageous to add a little water. In such a dry and warm region propagation can be delayed more safely until later in the season.

When propagation by means of scales is practiced in a region where the soil is too wet, it is a good plan to do it in sand and on the surface of the ground in a building or shed with a dirt floor. The scales can be broadcasted thickly and covered with an inch or two of sand. They should remain undisturbed until they begin to root, which will be in early to middle October, when with the attached bulblets they should be taken out and planted in the open ground, as previously described.

Frames with sash covers have the advantage that temperatures can be held a little higher at the end of the incubation period. This is a definite advantage where the season is short.

There is a decidedly different way of handling the scales which is advantageous under some circumstances. It will apply mainly to the grower who has a greenhouse. The space under the bench can be inclosed by burlap or in some other way to shut out the light and the ground covered with sand. The scales are spread one deep as thickly as possible over the surface of this sand, left until the first to the middle of October, and then planted out.

Under ordinary greenhouse benches in the region of Washington, D. C., the temperatures for the greater part of the time will be maintained at from 65° to 90° F. from July to mid-September and somewhat lower without heat in late September and October. It would be advantageous if the temperatures could be kept up to the end of the period, but a very good propagation can be had without it.

In this method of handling, the propagation is comparable with that of the hyacinth when artificially propagated. Indeed, the principle is the same, but it seems necessary to keep the scales on the surface of moist sand rather than on wire-bottomed trays, as is done with hyacinths. A higher degree of humidity is required than when incubated under 2 inches of sand, as the scales are entirely uncovered in the open air.

At first the temperature is kept preferably at about 70° F. with the surface of the sand barely moist. It can be run up to 80° or 90° F. after the cut ends of the scales are calloused, or in about two weeks. After this, a good supply of moisture is imperative. A good plan is to moisten the scales slightly with an atomizer every day or two. As soon as root growth starts on the bulblets they should be transferred to their permanent location in the field, whether it be in September or October. Root growth will be delayed by withholding moisture.

The advantage of this method of artificial propagation lies in the fact that there is induced under the higher temperature and humidity an accelerated growth. Indeed, the old scales are nearly used up, and if handled right the bulblets will be rooting and throwing up green leaves by mid-October. If propagated in the open ground they may not show leafage until the next spring. Of course, the sooner the old scales are transferred into bulblets and the sooner

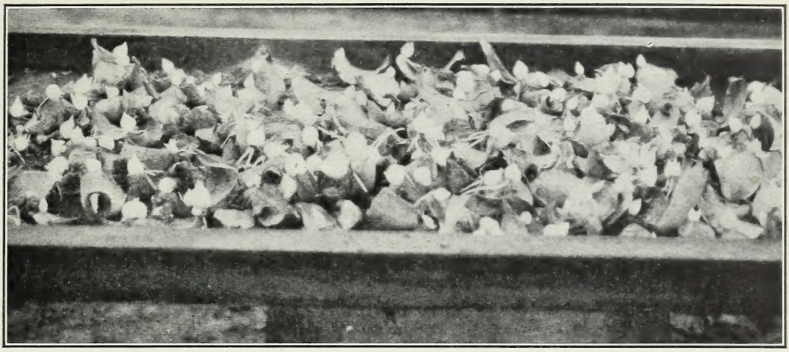

FIG. 1.—A PROPAGATION OF THE MADONNA LILY FROM SCALES PLACED IN AN INCUBATING CHAMBER WITH HYACINTH BULBS

FIG. 2.—BULBS OF THE MADONNA LILY

A normal bulb grown on sandy loam soil, on the left. On the right is an abnormal bulb grown on heavy Whatcom silt loam, showing scales in the neck of the bulb loosened by the heaving action of early spring frosts

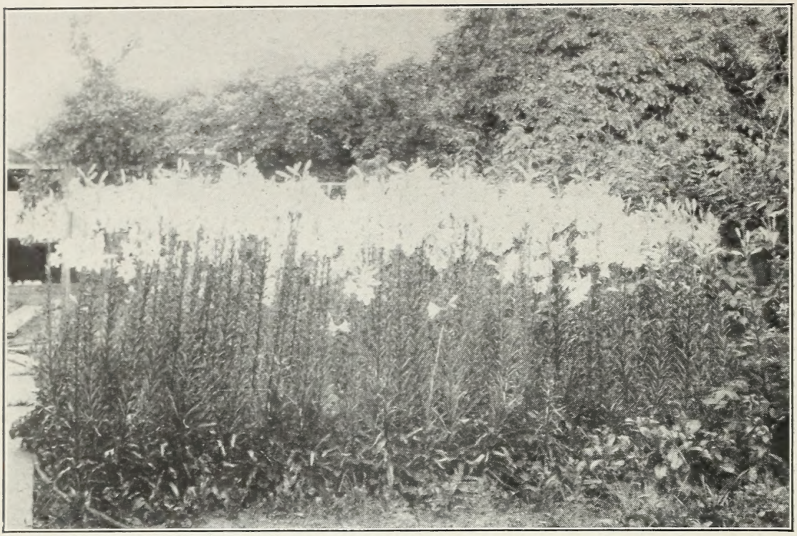

FIG. 1.—THE MADONNA LILY AS COMMONLY GROWN IN GARDENS ON PUGET SOUND

FIG. 2.—THE NANKEEN LILY GROWING AT BELLINGHAM, WASH.

This lily is propagated exactly like its parent, the Madonna lily, and is fully as easily grown. Stocks of it are very scarce

these bulblets are able to stand on their own feet, so to speak, by feeding from the air through their leaves, the better.

If for any reason propagation by scales can not be undertaken in its proper season, it is not necessary to lose a year by not propagating at all. One can still take advantage of the adaptability of the lily by making the propagation extend over the entire winter and spring. This may be particularly useful in case the grower wishes to propagate foreign bulbs the year they are imported. The stocks usually come into this country too late in the fall to do much with them outside except to plant and let them grow, to be propagated the next season.

A good propagation may be accomplished late in the season by layering the scales in late September to November and holding them until late May to June before planting in the field. To be certain of success with this method of propagation dry sand or other well-pulverized earth in a frost-proof place must be used. Again resort may be had to a shed with a dirt floor. The scales may be strewn thickly but in single layers, alternating with an inch or two of sand, built up in this way to a depth of 8 or more inches and the whole covered with enough straw or débris to keep out frost. On no account should any moisture be allowed to seep in on this propagation, and the pack is better when left undisturbed.

The scales may be arranged in the same way in shallow boxes, or the propagating bed may be made in a basement or dry root cellar. In such situations the temperature will be low and consequently the development of the bulblets slow, which is exactly what is desired in order to bridge over nearly a full growing season in the propagating bed. When the scales are put in in a normal season they go into the field in early October and make top growth before winter, but when planted late and kept cool and dry propagation is retarded, so that they need not be put in the field before June, when they will root, make top growth, and get ready for the second winter.

When the bulblets are taken from the propagating beds the whole mass can be shoveled carefully on to screens having a one-fourth-inch mesh to separate the sand, leaving the bulblets with the remains of the scales attached clean and ready to line out in the field.

The average grower will use for propagation the old, hard, firm scales of full size. It is possible, however, to manipulate the scales so as to get a considerable increase in the number of bulblets. Two or three scratches across the concave surface or splitting the base of the scale for one-third its length from the base upward will greatly increase the number of bulblets produced. E. T. Barnes considers that he can afford to spend the time to split the base of the scale in order to get the increased number of bulblets. The writer's experience has not been reassuring on this point, inasmuch as the yield of bulblets has always proved sufficiently abundant without employing these artificial means.

PROPAGATION BY STEMS

The third method of increasing the stock of the Madonna lily is by what may be called the stem method. This consists essentially of layering the bases of the old stems in comparatively dry sand for

about three months. It is best to prepare 18 inches or more of the bases of the stems by stripping off the leaves as soon as the flowers are cut. These old bases can be easily pulled out of the bulbs by giving them a slight twist and pull sidewise, apparently without injuring or disturbing the bulb.

These stem bases are then layered thickly on the surface of the ground under a shed, under a porch, in shaded frames, or in some similar situation and covered with 2 inches of sand. They are then left with little or no attention until the bulblets begin to grow roots, showing that they are ready to be planted in the field. Each old stem base should produce 10 or 12 bulblets 3 to 7 centimeters (1.18 to 2.76 inches) in circumference.

If the situation in which the stems are layered is suitable, reasonably protected, and shaded, they will scarcely need any attention. The main thing to look out for is to see that no water seeps on to them and that exposure does not cause them to dry out too much. Usually the natural capillarity of the shaded soil will be sufficient to prevent too great desiccation. The stems should be kept decidedly on the dry side, but not powdery dry. If water is necessary, it should be applied with extreme care, for if the soil is moist enough for ordinary plant growth it will cause decay of the stems in a few days. By far the best plan in making such a propagation is to select a situation so shaded and protected that there is always likely to be a trace of moisture present and then to leave the stems severely alone. A fair propagation will occur in very dry soil, but it will be infinitely better when a slight moisture content is brought up by capillarity. The writer has never been able to add moisture satisfactorily.

The stem bases may be incubated in precisely the same manner as described for the scales. Whenever that method is employed for the scales it is recommended that the stems be included with them. The stem bases may be laid on the surface of the sand, but it is often more satisfactory to lay them on trays having a galvanized-wire mesh to keep them from actual contact with the sand. In the experiments recorded in this bulletin the bulblets have usually finished their growth and begun to root, indicating the proper time to plant them out, in 45 days. They attain a size of 3 to 7 centimeters (1.18 to 2.76 inches) in that time.

Possibly the easiest way to handle the stems for propagation when the flowers are not to be used is to heel them in in the field in such a way that a foot or so of the base of the stem is covered with 1 to 3 inches of friable soil. With this treatment, the whole stem should be used with no leaves removed. Under ordinary conditions the stems can not be successfully layered in the open ground in either the Puget Sound region or at Washington, D. C., on account of excessive moisture present in the soil, but when heeled in with the tops on, the stems continue to function long enough to allow the formation of bulblets to take place before decay starts. Under this treatment the bulblet formation will be ready to space in its permanent quarters on Puget Sound in the first half of October and a few weeks earlier in the vicinity of Washington, D. C.

PROPAGATION BY SEED

Contrary to popular belief, the Madonna lily can be very readily reproduced from seed. The seed is sown preferably one-half inch or less deep in any good potting greenhouse soil. It germinates in three weeks and can be picked off into 2-inch pots when in second leaf. If sown from November to January the plants will crowd in 2-inch pots by about the middle of April and will be ready to be transferred to the field. The seedlings may be left in the flats and transferred directly into the open ground if care is taken, but it is better to pot up first. The seed can also be sown in frames or even in the open ground if a good seed bed is prepared. When sown in the open the seed should be covered about an inch deep. It can be sown in the autumn or preferably in very early spring in the climates of Puget Sound or Washington, D. C., but in very much colder localities very early spring seeding seems to be imperative.

For out-of-door planting the writer prefers to put the seed in at the rate of four or more to the inch in rows 6 inches apart. The seedlings are left two years and then dug and spaced during their dormant season.

Seed held under ordinary conditions will germinate readily in autumn or spring if the temperature and moisture conditions are suitable. It holds its viability perfectly until the second year, but after that it deteriorates rapidly and the third year is scarcely worth planting.

MAKING A SEED CROP

The Madonna lily is looked upon as a nonseeding species, and it is rare that seed is seen, though it is a good seed producer when conditions are suitable. Of its own volition it rarely seeds, because the structure of the flower is such that pollination is seldom effected, but when properly pollinated it seeds readily and quite abundantly. This has been demonstrated the past few years with several lots of seed which have been obtained from widely scattered localities. Some of these were accidental and others the result of hand pollinations.

When seed is desired, the plants should be visited every morning. The writer has found that between 8 and 10 o'clock seems to be the proper time for pollinating under conditions obtaining at Washington, D. C. At this time every stigma which is viscid should have freshly opened pollen applied to it. This can be accomplished without the use of instruments. Three to five seed pods to a plant are sufficient. Sometimes it will be found that the plants are short of pollen. If the whole stock is short, one can resort to the use of pollen from some other lily, a good one to use, if it can be had, being the Easter lily (*Lilium longiflorum*). This commonly gives a set of seed which produces true *Lilium candidum* as though its own pollen were used. Usually, however, there is no difficulty in getting enough of its own pollen, but some colonies have been found which produced very little.

The production of a crop of seed interferes very decidedly with any other form of propagation which one may want to perform. For any artificial vegetative propagation one may want to conduct it is

necessary to dig the stocks as soon as the flowers fade, but it will take two months longer for the seed to mature, making it altogether too late that year for vegetative propagation except in the warmer long-seasoned sections of the country.

The season is commonly rather too short on Puget Sound to mature seed out of doors. When a set is obtained, however, the stems can be cut on the advent of cool weather and put in water in a warm room or greenhouse, where they will complete their development. It must be remembered that heat is necessary to finish this maturity, because the pods decay under low temperatures even indoors where no water gets on them.

SOILS

The Madonna lily is adapted to a great variety of soils, but the grower who produces in quantity will be fortunate if he has a rich sandy loam, well drained but with a good moisture content from late August to June. Any good loam will do, but it must be well drained, friable, and, above all, not what is commonly designated as cold or plastic clay.

Liming is usually advised for this lily both in England and in this country, but some of the best successes are often attained without its use. The Department of Agriculture has had as good success in the Pacific Northwest on unlimed as on limed soils, the former being but two years ameliorated by culture alone from the usually acid forest floor.

SOILS THAT HEAVE SHOULD BE AVOIDED

On the heavy retentive Whatcom silt loams of Puget Sound the bulbs of this lily are likely to be heaved out of the ground in late winter. At times, when the lifting action is less severe, the injury may be quite serious without moving the bulbs. It is a peculiar effect.

This lily, as is well known, starts growth in August and goes through the winter in vegetative condition. There is a rosette of basal leaves which should go through the winter uninjured. These leaves develop from the inner scales of the bulbs. When the pull on them is exerted by the heaving action of successive freezes, their weaker tissues finally rupture. These tissues are located at the base of the scales at the attachment to the basal plate of the bulb. The result is that the leaves soon wilt and die, and the scales, 6 to 10 or more in number, remain loose in the neck of the bulb, as shown in Plate I, Figure 2, until digging time, when they drop out, leaving the bulbs very much disfigured and not suitable for commercial use, although satisfactory for continued growth and often even for forcing.

The pulling loose of these inner scales does not destroy the growing point, and the plants consequently blossom all right the season following the injury as well as the subsequent one, but, of course, with reduced vigor, as the destruction of the leafage robs them of just that much of their elaborating surface, which normally functions until the plants blossom.

PLANTING

This topic has been discussed in part under the subject of propagation. It remains to consider here the method of handling the bulbs and bulblets which go back into the field, be it remembered, not later than the first half of September and very much better in August.

As is advisable with all bulbous stocks, it is desirable to size carefully the planting stock, so as to secure a more even distribution of the plant material. This sizing is all handwork, for these bulbs can not be handled by any mechanical sizer yet invented. Its accomplishment gives an opportunity to cull out questionable material at the same time. Where any considerable quantity of bulbs is handled it will usually be found advantageous to make three sizes. The first, or largest, made up of bulbs 10 to 15 centimeters (3.94 to 5.91 inches) upward, should be set up at regular intervals in whatever form of planting is adopted. The next size should also be set up, but the smaller size may be strewn along the rows without any attempt at an upright placement.

The form of the planting will depend on circumstances and the desires and preferences of the grower. In this country the tendency is toward a thin planting in rows 2½ to 3 feet apart, with the plants, depending upon their size, spaced from 6 inches apart for the large bulbs to an inch or less for the smallest bulblets. In this sort of a planting horse or wheel-hoe cultivation is practiced.

The Dutch bed method of planting has some decided advantages over any other which has been tried in its adaptability to a more economical use of fertility, to economy of space, and, in the writer's opinion, to economy of labor.

When this form of planting has been used, the scheme for tulips and daffodils has been modified so that the 6-inch row has been widened to 9 inches, and only five to seven of the larger bulbs are set in the 3-foot row across the bed. In this case the bed may be laid off as for a 6-inch row, but the planting is done on the 6-inch line and midway between lines, giving a 9-inch space between the planted rows. This modification is necessary for the larger sizes only. When the smaller sizes are planted, the 6-inch row is adopted again.

A very good modification of this Dutch bed system may be made by planting in rows lengthwise of the bed. In this case 8-inch rows are advantageous, every sixth row being left vacant for a path between the beds, thus forming a 40-inch bed.

In practice, this longitudinal-row bed method can be opened up and covered with a hand plow. This plow will not usually open a furrow deep enough for setting the big bulbs with their roots on. Hence, in this form, as well as in planting the Dutch bed proper, a garden trowel must be employed to increase the depth for the roots. The depression made by a hand plow can be made just right for the smaller sizes, however. The Madonna lily may be planted shallower than many species.

An economic comparison of the bed and row methods is not easy, and it seems better simply to mention both methods without attempting to decide between them. The row method has the single advantage of making it possible to use horse power a part of the season

to keep down weeds. It has the disadvantages that always accrue from the tramping of animals on the soft bulb ground and from the use of horse tools among plants, which are sure to receive more or less mechanical injury. The advantages of the bed system have already been stated.

CULTIVATION

As stated, row planting presupposes some regular cultivation. The bed system assumes that weeds are kept out, but no stirring of the soil is contemplated except in the paths. A narrow hoe can be used nicely between the 8 or 9 inch rows advocated while the plants are small. After the autumnal growth of the large plants is fully developed the ground should be fairly well covered, choking out most of the weeds. The few that come up after that must be taken care of by hand. Of course, the beds should be thoroughly gone over and cleaned up during July and August, when the plants are dormant.

In any planting of this lily the soil should be so loose and friable naturally that little or no benefit will be derived from stirring it after planting. The interference of tools with the natural root development close to the surface of the ground more than offsets the advantages of the added aeration thus induced. The paths in a bed planting are kept clean with a wheel hoe.

DIGGING

Digging this as well as most other lilies will commonly be done with a spading fork. When row planting is practiced, the operation can be assisted considerably by barring off the rows on one side with a 10-inch plow, but it is doubtful whether an attempt to plow out the bulbs can be carried on with sufficient care so that they will not be bruised. In a regular bed planting the bulbs are most advantageously taken out with a short spade, as are Dutch bulbs generally.

It is usually better to dig with the tops cut off a few inches high, shake out the soil from the clump, and lay the bulbs in small piles, which are soon to be gone over by hand to cut off the stem bases; then the bulbs are removed to the storage house to be sized and sorted. Care should be exercised not to leave the bulbs exposed to the sun. The hotter the weather and the clearer the atmosphere the more important this injunction becomes.

HANDLING THE BULBS

Care in handling should be the watchword all along the line. Lily bulbs are so delicate that even pouring them from one container to another is likely to cause decided injury. When a transfer is necessary it is wise to use a scoop [1] rather than to pour them from one basket or pail to another. Shovels or even small hand scoops such as are used to handle tulips and daffodils can not be employed to take any but the smaller sizes of these bulbs off of trays or shelves, and even with them the loading of the scoop should be accomplished mainly with the hand, to prevent bruising.

[1] These scoops are homemade contrivances with curved bottoms and slightly converging sides, facilitating transferring the bulbs without bruising. They are illustrated and described in U. S. Dept. Agr. Bul. 1082, The Production of Tulip Bulbs.

Even in the handling of the smaller sizes there is great danger of bruising whenever it becomes necessary to transfer the bulblets from one vessel to another. The grocer has learned how to transfer cherries from a box to a bag without injury. Masses of bulblets of the Madonna and other lilies should be picked up in the same way from baskets, lug boxes, or bulb-house trays.

In no case should the bulbs, either large or small, be held in piles when there is danger of the slightest heating or bruising from the weight of upper layers.

The conditions under which the bulbs are held in the interim between digging and planting, which should be as short as possible, should be such that the bulbs will not heat or mold, on the one hand, and not dry out too much, on the other. This bespeaks a dry cool basement, where the ventilation can be readily controlled.

WHERE THE LILY MAY BE GROWN

Like most plants of wide application to man's needs, the Madonna lily may be grown under a great diversity of climatic conditions. Apparently it is perfectly adapted to our North Pacific coast (Pl. II, fig. 1) and is being successfully grown in limited quantities from the Canadian border well into California. Michigan has produced good stocks, as have also our North Atlantic States. North Carolina and Tennessee report sufficient successes to suggest commercial possibilities, and attempts at its initial commercial propagation are being made in central Florida. One striking success is chronicled from the Eastern Shore of Maryland.

For ornamental purposes the lily succeeds as far south as Florida, and even in the interior valleys of California, where the temperature at times runs up to 115° F., it does fairly well when carefully watered and partially shaded. Successful commercial culture, however, is more promising where the summers are not hot and the winter season is more rigorous, such as regions in our middle latitudes and the northern portions of both coasts.

CLIMATIC ADVANTAGES

There is little question in the writer's mind that, other conditions being equal, a maritime situation has decided advantages in the aboveground handling of the Madonna and many other lilies. A cool, moist atmosphere in which the bulbs can be stored without danger of drying out too much is a decided asset. This fact impresses one greatly on the North Pacific coast, where this lily not only grows to perfection but the bulbs are often seen lying around in a way that would assure complete destruction in the higher temperatures and under the greater desiccating influences of the atmosphere of Washington, D. C.

A moist atmosphere and uniform low temperatures make for ease in handling and marketing which are not to be ignored lightly. This does not mean that this lily can not be well grown and handled in a drier and warmer climate than that of the Pacific Northwest, but it does mean that such a climate will necessitate the exercise of greater care while the bulbs are out of the ground both in storage and transit, for it takes but a few days of exposure to cause excessive wilting of the bulbs in dry hot situations.

THE BULBS AFTER FORCING

Forced bulbs can be used very advantageously for growing on, or they can be scaled for propagation and the stem bases used for the same purpose, as described elsewhere, when the pots are not sold. As with the field-grown stocks, the propagation in whatever form can be done as soon as the flowers have faded or, since in this case the blossoming is early in the spring, the bulbs can remain in the pots for a month or six weeks before being propagated. Whatever way it is done, the scales will give rise to bulblets which will come into leafage in autumn and go through the winter in vegetative condition, as usual with mature bulbs.

COMMERCIAL SIZES

The bulbs of the Madonna lily are naturally much larger than those of other commercial lilies. On the market one seldom sees bulbs smaller than 18 centimeters (7.09 inches) in circumference, and they may reach as high as 30 centimeters (11.81 inches). Formerly the larger sizes, known as "jumbos," were common enough on the market, but since the war the smaller sizes have been the only ones seen. Bulbs are sold according to size, the quotation being usually for a circumference varying about 2 centimeters (0.79 inch) each from 18 centimeters upward.

PACKING AND SHIPPING

The Madonna, like other lilies, is commonly shipped in boxes containing 100 to 200 or more bulbs, depending on their size. The packing material in foreign shipments may be a fibrous peat or soil. The purpose of the packing material is to protect the bulbs from mechanical injury and where they are in transit for a long time from excessive desiccation.

In the shipment of large bulbs by express, packing in sphagnum moss, grain chaff, or the lighter fibrous peats is very satisfactory. Sawdust is such a variable product that it is not safe. Old well-weathered material of some hardwood, redwood, or cedar is more likely to be satisfactory than pine, which contains too much turpentine and rosin. The objection to old weathered sawdust is that it is likely to absorb too much moisture from the bulbs.

There is a possibility of adopting the conventional fruit pack for the domestic shipment of these lily bulbs. Each bulb wrapped in newspaper and packed tightly in apple boxes has traveled in very good condition by freight from Puget Sound to Washington, D. C. This may prove to be the simplest form of pack.

It has been found that planting stock consisting of bulblets and scales carries very nicely in shipments across the continent by express when a pint or less is put in paper bags and these bags are packed tightly in boxes. This breaks up the bulb mass so that sweating and heating do not occur in the center. A loose wrapper in the form of a light corrugated paper around the bag will give additional protection where necessary.

Seedlings are readily transported when in second leaf or later. They are removed from the soil and laid four to six deep on a ribbon

of barely moist sphagnum, extending only to their former ground level. When all have been arranged this ribbon, with oiled paper under it extending far enough to envelop the tops, is rolled tightly, tied, and packed several in a box. In such a pack seedlings will go across the country by mail without suffering if care is taken to see that the tops are kept dry and the roots barely moist.

TRANSPLANTING EASY

In spite of the emphasis placed on keeping the bulbs out of the ground as short a time as possible and the necessity for early planting, the Madonna lily is very easily handled. It can be moved at almost any time of the year if ordinary care is observed and will still grow and flower as though nothing had happened to it. Instances are known where all the bulbs of a considerable planting were heaved out of the ground on the Whatcom silt loams of the Bellingham Bay region during the winter. These bulbs were shoved back into the ground in the spring. They were injured, of course, but they all flowered. These lilies may often be transplanted while in bud, seemingly without injury to their flowering quality.

In ornamental plantings it is sometimes necessary to move the plants after top growth starts in the fall. This can be done with very little injury by taking about the same care as would be necessary in moving ordinary shrubby perennials. But one can not, without serious loss, dry off the plants or otherwise abuse them by keeping them out of the ground a long time. When moved in vegetative condition they should be reset immediately, as should be done with any shrub.

METHODS OF CULTURE APPLICABLE TO THE NANKEEN LILY

The methods outlined here are applicable in the propagation and handling of a number of other lilies. The garden hybrid, *Lilium excelsum* (*L. testaceum*, *L. isabellinum*), commonly referred to as the Nankeen lily (Pl. II, fig. 2), can be handled in all respects like the Madonna lily, and it does as well, too, on Puget Sound. There is reason for believing this to be a cross between the Madonna lily and *L. chalcedonicum*. It is very easily propagated in exactly the same way as the common Madonna lily. There are but few records of the Nankeen lily having produced seed, but the indications are that in this respect also it simulates the Madonna very closely.

ADVANTAGES OF HOME PRODUCTION

Attention has been called to the necessity for the early handling of the Madonna lily. It should be in the hands of the consumer early and should be potted up or planted out in early August. This is manifestly impossible when the bulbs commonly do not reach this country until September. It is evident that with home production the bulbs can be put on the market earlier and be out of the ground a shorter time than when they have to be shipped from abroad.

ENEMIES

The Madonna lily has one enemy which at times is said to cause serious losses, but in the investigations of the Department of Agri-

culture it has not been encountered in serious form. It is caused by a Botrytis, the same mold or one closely related to that causing fire-blight in the tulip. The disease is at least assisted in its progress by lack of aeration caused by weeds and shade, which prevent the foliage from drying off as it should during the day. The presence of excessive quantities of strawy litter and particularly lack of drainage combined with the above furnish ideal conditions for the development of the fungus.

This disease is easily recognized by the browning of the leaves in spots or in their entirety and the mummification and molding of the unopened buds. It attacks the stem leaves and the basal growth and is usually particularly destructive from the time the stem is a few inches high until the time of blossoming.

Little can be done to stop the inroads of the trouble after it once gains headway. Two or three applications of Bordeaux mixture at intervals of two weeks after growth is well started in the spring are quite efficacious in holding the disease in check. As is the case with so many bulb maladies, the main preventive is care and cleanliness in handling. The old foliage and stems should be removed from the planting and composted, to be used on other crops, so as not to allow the accumulation of disease organisms in the soil for another year, when conditions may again be favorable for their development and spread.

The American lily rust (*Uromyces lili* Clint.) at times is quite serious and likely to be particularly aggravating from the fact that it can get into one's stocks at any time from native lilies, for it is indigenous in our northern climates. This disease is easily recognized with the unaided eye. It causes small circular to elliptical rusty pustules, mainly on the under sides but commonly on both sides of the leaves. It is likely to be particularly severe on the Madonna lily when seminaturalized in shaded situations, but some severe attacks have been noted in these investigations under open field conditions.

Fortunately, the disease can be controlled by the persistent use of Bordeaux mixture as a spray from the time growth is well started in the spring up to about the time the buds begin to show. How often the spray should be applied will depend on weather conditions. Heavy rains which wash off the spray should be followed by another application after the weather settles. Thorough work for two seasons should eradicate the trouble unless reinfection occurs from native stocks or some other source.

Many other lilies are susceptible to this disease. Our important Pacific coast species are subject to it, but the Easter lily (*Lilium longiflorum*) and the Regal lily (*L. regale*) are very seldom but slightly affected.

Basal and edge scale rots in the bulbs of lilies are usually looked upon as diseases, but the writer has found no organism which seemed to account for the trouble. Of course, it is possible in nearly every case to isolate black-mold (Rhizopus), blue-mold (Penicillium), and Fusarium from the affected tissues, but these organisms are likely to be present almost everywhere, and in lily bulbs it is thought they are to be looked upon as a consequence of a diseased condition caused by some other agency. It is usual to find the bad condition of the

bulbs due to some untoward feature of culture, handling, or storage. Commonly, edge-scale and basal rots are the results of poor drainage, shallow soil, heavy plastic clay, or too much decaying organic matter, particularly raw manures in the soil. These agencies have a deleterious effect upon the delicate bulb tissues and start the rots. The decaying tissues form the best kind of medium for the development of molds, which in their turn are able to assist in the progress of the diseased condition. Manifestly, the remedy is to improve the faulty conditions and give the bulbs a chance to recover. It is well to remove the scales from the bulbs to firm tissue, and, after drying slightly, reset the bulbs under first-class conditions, when they will usually recover and make good stocks.

Of fully a hundred samples of this type of lily disease which the writer has examined during the past 10 years, not one has been considered more serious than here described. Healthy plants have actually been grown from some of these specimens under both pot and field conditions.

Of insect enemies there are usually none which need attention except the green and gray plant-lice or aphids. When they occur either in the greenhouse or the field a spray of nicotine sulphate used according to the directions on the packages, a fine tobacco powder or dust, or fumigation with the conventional nicotine products will keep them in check.

As with most crops, the good grower will have far less trouble with diseases than the poor one. Putting the plants in an environment and under conditions suited to their needs will solve most of the so-called disease difficulties.

GROWING UNDER GLASS

The Madonna lily is perfectly adapted to be grown under glass for winter and spring flowering; indeed, up to about the year 1880 it was largely so used. It was the Easter lily up to the advent of the "Bermuda lily" (*Lilium longiflorum*), which now comes mostly from Japan.

The Madonna lily should be potted up earlier, but otherwise does not require especially different treatment from *Lilium longiflorum* except that it can not be forced quite so hard. It is said to be especially impatient of high temperatures until after mid-January. It can be nicely timed for Easter, however, and late in the season it will stand perfectly a temperature of 65° F. at night. Liberal feeding with liquid manure is desirable after the buds show.

Like the field-grown plants it should be potted comparatively shallow and can be allowed to root and make basal leaves in plunged pots out of doors, where it can remain to receive some freezing, which it is claimed makes it force better, although in the writer's experience no such difference has been observed.

THE MADONNA LILY IN THE GARDEN

The failures with the Madonna lily under garden conditions result from various causes. Chief among these are bad soil mechanics, poor drainage, too much coddling, poor handling, too deep planting, and, last but not least, too much shade.

The lily is well adapted to the sunny border. Like most lilies it thrives better when its feet are shaded, but its shade should not be dense or high. The plant can not compete with the roots of trees and shrubs.

Having obviated these difficulties and selected a place otherwise suitable, good results can be expected from these lilies for years without disturbing them, though it will give better results if they are disturbed once every three or four years, for under conditions of good fertility the bulbs soon become crowded, with a consequent dwarfing of the individuals.

GARDEN ASSOCIATIONS

In the ornamental garden as well as under field conditions the Madonna lily needs to be in full sun. Unless the plants are scattered more than massing effect warrants, there is very little that can be grown between them, for they occupy the ground quite fully and when properly spaced cover it entirely with their basal leaves after September if the plants are thrifty.

Of course, the lily may be spaced or grown in clumps where bedding plants which blossom early can be grown between. It is exceedingly effective in front of banks of shrubbery but sufficiently removed not to be influenced by root competition. When grown close to shrubs it is well to cut off the shrub roots once a year in order to protect the lilies from deleterious competition.

PRESENT CONSUMPTION

It is rather remarkable that a florist item of such recognized and acknowledged quality should have been supplanted so decidedly in the past 40 years. For this condition there are two main reasons: The modern Easter lily (*Lilium longiflorum*) has assumed ascendency because its price has become more advantageous, and its supplies more dependable. Aside from its intrinsic merit the bulbs of *L. longiflorum* are cheaper, and other merchandising advantages are in its favor. It is equally remarkable that in spite of these facts the demand for bulbs of the Madonna lily in this country still continues and is now greater than the present foreign supply. Our imports in 1922 were somewhat more than 600,000 bulbs, used in largest measure for outside plantings.

The Madonna lily is admirably adapted for forcing, for use as cut flowers from the field, and for a great variety of decorations in the garden, for which it is more extensively employed at the present time than any other lily. The demand for these purposes now is nearly three-quarters of a million. The indications are that more would be used if the supply was greater and more dependable. It is also probable that a more satisfactory supply would in a measure revive the use of this lily for forcing, for it is as suitable for altar and similar decorations as the modern substitute. Single large well-grown specimens are especially decorative, and an assemblage of four or five plants in 10-inch pots is attractive in any situation. As a cut flower this lily has no superior, and cutting it does not interfere with its bulbs or its propagation.

SUMMARY

Dig, reset, and propagate the Madonna lily early in the season. Propagation can be most advantageously done when the plants are in full blossom. There is no advantage to be gained by delaying the operation beyond the time when the flowers fade.

The Nankeen lily can be handled in all respects like the Madonna, one of its parents.

Some other lilies can be advantageously propagated when in blossom, and this time of handling is probably of quite wide application to the genus.

If for any reason it is necessary to propagate the Madonna lily late in the season it can be done in a dry, cool, frostless situation during late autumn, winter, and spring, so as to bridge over an entire growing season.

Stocks of the Madonna lily may be increased by seed, by natural division of the bulbs, by scales, and by stem propagation.

Under field conditions with good culture and friable well-drained soils having a good moisture content there is little trouble with pests.

The culture of this lily on soils that heave in winter should be avoided.

Careful hand pollination will produce an abundance of large seeds which germinate promptly and retain their germinating power perfectly into the second year.

Like most lilies, the Madonna is readily transplanted under the same precautionary measures that one should take with any perennial shrub or herb.

The Madonna lily is deserving of a larger use than is now being made of it as a florist item, and no species is better suited or more extensively employed in garden decoration.

Under commercial handling this lily can be advantageously reset every second year, but under ordinary garden conditions it seems better to leave it undisturbed for three or four years. If the situation is well suited to its growth it will function satisfactorily for a much longer time.

Root development on the propagation, whether from stems or scales, is retarded by keeping the moisture supply low.

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